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SOME DETAILS OF THE REPRODUCTIVE STRUCTURES OF SARCODES

Bernice E. Doyel and L. Marguerite Goss

The genus *Sarcodes* includes but one species, *S. sanguinea* Torr., the snow flower, a fleshy, saprophytic plant common in the Sierra Nevada in California. This familiar plant has been described in detail by Oliver (6).

Each plant consists of a tuft of roots and a stout erect stem which bears spirally arranged scales. The abundant flowers are borne in the axils of the upper scales; the lower part of the stem may be regarded as a peduncle, and the upper as the rachis of a raceme. The stem, scales, pedicels and sepals are densely covered with multicellular glands. All parts above ground are brilliant crimson.

The flowers are ordinarily pentamerous. The sepals are separate; the petals are united for about half of their length and are entirely glabrous. The corolla and calyx are about equal in length; the tips of the petals curve outward while those of the sepals are slightly incurved. The stamens are ten in number, hypogynous, considerably shorter than the petals and slightly shorter than the pistil. The anther is about half the length of the entire stamen. The filament is ribbon-like, entirely glabrous, and attached to the outside of the anther a little below the middle. Dehiscence takes place by a pair of pores on the outer surface of the anther near the summit. The pistil is glabrous. The oblate-spheroidal ovary is marked by ten grooves in the planes of the filaments; at the base it bears a nectary with ten blunt lobes located between the grooves and projecting between the bases of the filaments. The internal cayity of the ovary is divided by five radiating septa located in the planes of the sepals and bearing massive placentae; in the lower part of the ovary the inner ends of the placentae are fused together so that the placentation is axile, while in the upper part they fail to meet and the placentation is parietal. The placentae bear a very large number of ovules. The cylindrical style, about as long as the ovary, is traversed by an open channel into which ridges, being upward continuations of the septa, project. The capitate stigma is five-lobed; the lobes are placed alternately with ridges which project into the style-channel: that is, they are the ends of the carpels.

We are able to amend or extend Oliver's description by observations of the vascular system of the receptacle, the structure and development of the stamen and the embryogeny. The observations are based on material supplied by Dr. Herbert F. Copeland, to whom we are most sincerely grateful. The material was collected at Jonesville, Butte County, at an altitude of 5000 feet, and fixed in Bouin's fluid. In making slides the usual microtechnical methods were employed and safranin and light green were used exclusively as the stains.

Madroño, Vol. 6, pp. 1–32. January 17, 1941.

Vascular Anatomy

The vascular tissue of the stalk—the peduncle and the rachis of the inflorescence—is to be interpreted as a cylinder, in which, however, the xylem is broken up into separate strands (Pl. 1, fig. 1). There is no sheath of fibers outside the phloem.[1] The departure of each leaf trace leaves one gap in the cylinder; the leaf trace is apparently to be interpreted as a single bundle but early in its course it frequently divides into two and before it enters the leaf breaks up into many. The vascular supply to each flower originates as two bundles, springing from the sides of the leaf-gaps just above the departure of the leaf trace; the two bundles unite in the cortex to form a cylinder, which enters the pedicel. In traversing the pedicel it breaks up into a ring of some five or six bundles.

As the bundles enter the receptacle (Pl. 1, fig. 2), a series of six whorls is given off in acropetal sequence: (1) a whorl of five sepal bundles; (2) a whorl of five bundles alternating with the sepal bundles, each of which splits tangentially into (a) several outer bundles that enter the corolla and (b) one inner bundle supplying an antipetalous stamen; (3) a whorl of five antisepalous stamen bundles; (4) a whorl of many carpel lateral bundles, arising on the inner sides of the bases of all the stamen bundles, and ascending the ovary wall; (5) a whorl of carpel dorsals ascending the ovary wall in the planes of the petal bundles; (6) a whorl of placental bundles in the planes of the sepal bundles. All the bundles in the ovary wall fade out just before reaching the style. The placental bundles enter the ovary in the planes of the septa and continue into and up the style. They fade out in the stigma.

The Stamen

In the youngest stamens we have seen, the relative sizes of the parts are about as at maturity; that is, the filament is rather

[1] "My statement [5] that there is a sheath of fibers in *Sarcodes* was based on inadequate observation"--(orally communicated by H. F. Copeland).

Explanation of the Figures. Plate 1.

Plate 1. Sarcodes sanguinea Torr. Fig. 1. Cross section of peduncle, ×4. Fig. 2. Half of a model of the vascular system in the receptacle, seen from the inside, ×16: *ca,* sepal bundles; *co,* petal bundles; *st,* stamen bundles; *cd,* carpel dorsals; *cl,* carpel laterals; *plac,* placental bundles. Fig. 3. Juvenile stamen, ×16. Fig. 4. Diagram of a longitudinal section of a stamen, showing the course of the vascular bundle, ×16. Fig. 5. Cross section through anther, showing pollen chambers at the plane represented by the line *a* in figure 4, ×40. Fig. 6. Mature stamen, showing open pores, ×16. Figs. 7, 8, 9. Cross sections of mature anther, the planes of which are represented respectively by the lines *a, b, c* in figure 6, ×40. Fig. 10. Cross section of anther wall, being an enlargement of the area marked by the dotted square in figure 9, ×320.

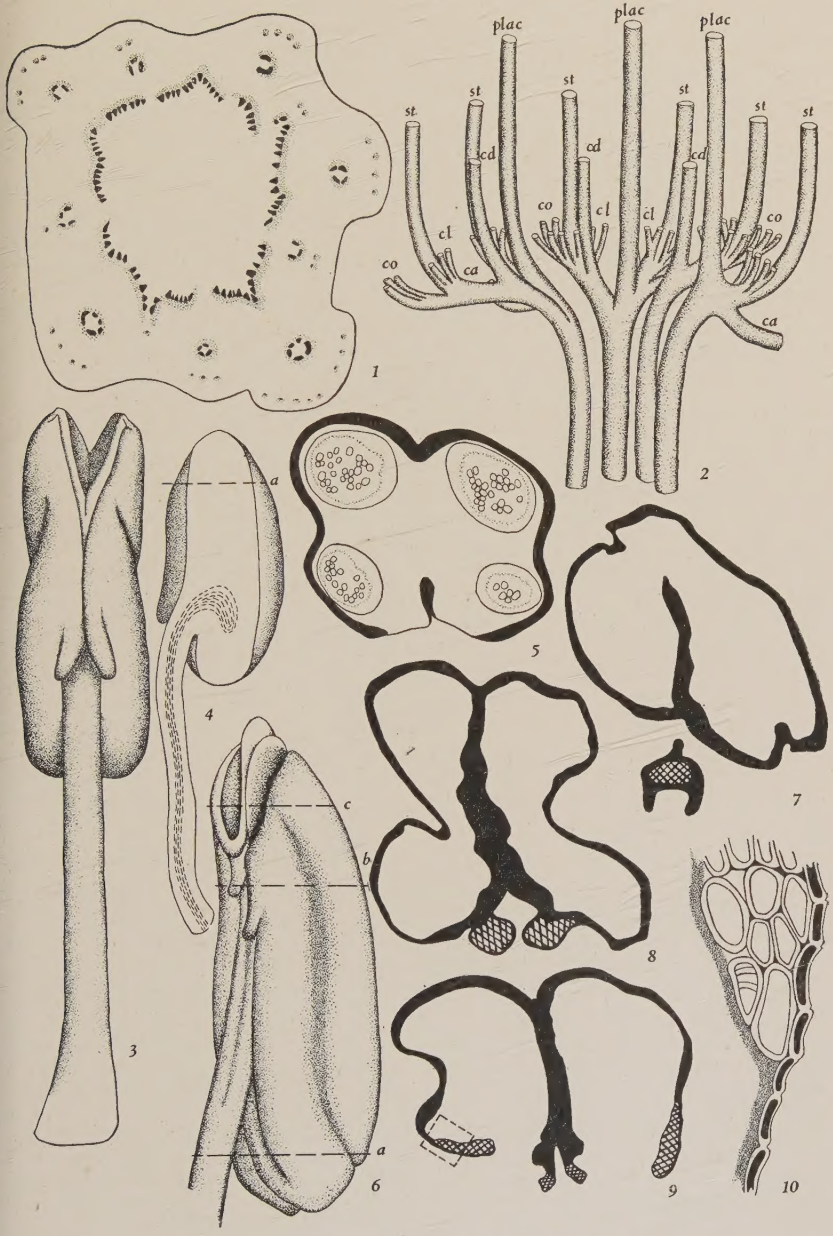

PLATE 1. SARCODES SANGUINEA TORR.

longer than the anther and enters on the outer side below the middle (Pl. 1, fig. 4). The stamen bundle bends so as to run not to the summit of the anther but to the lower end. The anther bears two rudimentary descending horns just above the insertion of the filament on the outside and below the pores (Pl. 1, fig. 3). In the young anther the usual four microsporangia with wall and tapetum are present (Pl. 1, fig. 5). The two pollen sacs on the inner side of the stamen extend somewhat nearer to the summit than those on the outside. The cells of the epidermis or exothecium are tanniniferous except for a patch on the outer side of the upper end of each anther lobe extending across the ends of the two microsporangia of the lobe where the pores are to form. In the youngest material we have examined the pollen grains had already formed. Most of them are four-grooved.

As the anther matures the wall between the two microsporangia of each lobe breaks down (Pl. 1, figs. 5, 7, 8); the connective (the wall in the plane of symmetry) also breaks down through a small part of its extent at the base of the anther; for the most part it persists. Where the pores are to form, and below them in the horns, a body of cells within the epidermis becomes differentiated by thick ribbed walls (Pl. 1, fig. 10). Dehiscence appears to be accomplished by a contraction of the exothecium which tears the body of thick walled cells in two by a lengthwise slit; the slit becomes a pore rimmed by thick-walled cells (Pl. 1, figs. 6, 9).

Embryogeny

The ovules have an integument of about four layers of cells. In the young ovule a few cells of the outermost layer show indications of tannin being present. Later, nearly all the cells of this layer are tanniniferous. The embryo sac develops in the manner usual in Sympetalae. The archesporial cell forms a megaspore tetrad. The spore at the chalazal end of the tetrad enlarges (Pl. 2, fig. 11); its nucleus undergoes three successive divisions which result in four nuclei at the chalazal end and four nuclei at the micropylar end. One nucleus from each end moves toward the center of the embryo sac; there these two nuclei unite to form the endosperm mother nucleus. Cell membranes form around the remaining six nuclei. The three resulting cells at the chalazal end are the antipodal cells. The largest of the three at the micropylar end is the egg and the other two are the synergids (Pl. 2, fig. 13). Meanwhile, the nucellus and the other three spores have disappeared. Following fertilization and before the embryo divides, the endosperm goes through a series of divisions. Each nuclear division is followed by cell division and the first two divisions produce a row of four cells (Pl. 2, figs. 14, 15). The second and third cells of this row (counting from the micropylar end)

PLATE 2. SARCODES SANGUINEA TORR. Longitudinal sections of ovules and young seeds in successive stages of development. FIGS. 11–18, ×160. FIG. 19, ×80.

divide repeatedly and produce many cells while the first and fourth cells develop into haustoria (Pl. 2, figs. 16–19). At the same time the antipodal cells and the synergids disappear. The zygote first divides into two cells after the endosperm is past the four-celled stage (Pl. 2, fig. 17); of the two daughter cells of the zygote, the one toward the micropyle elongates and forms a suspensor. The suspensor carries its sister cell up to about the level of the wall between the first and second cells of the four celled endosperm. The original suspensor cell undergoes no divisions and grows no farther; its sister cell, by a series of divisions, adds to the suspensor, so that the summit of the embryo is carried in among the cells derived from the second cell of the four-celled endosperm. In this region a globular mass of cells, the definitive embryo, is developed (Pl. 2, fig. 19). By this time the integument has for the most part been absorbed, except for the outer layer of cells which have become thick-walled; the seed is essentially mature.

Discussion

Copeland (1, 2, 3, 4, 5) has made several contributions to the knowledge of the details of the reproductive structures of Monotropoideae. Our studies show that the details of the reproductive structures of *Sarcodes* are essentially in agreement with what he has found. The outer whorl of stamen bundles and the carpel-dorsals are in the planes of the petal bundles. The placental bundles are in the planes of the sepals. The embryo sac is normally developed and of normal type. In certain minor details of the development of the embryo, in which, according to Oliver's figures, *Sarcodes* is different from other Monotropoideae, we were unable to corroborate his findings; apparently *Sarcodes* agrees perfectly with other members of the group.

The integument of most Monotropoideae is of just two layers of cells and the endosperm is of but few cells. The four-layered integument and the mature endosperm of many cells in *Sarcodes* are distinctive characters of the genus.

The course of the bundle in the anther, running as it does to the base and not to the summit, shows that the end of the anther which is toward the base of the flower is the distal end and the end toward the summit of the flower is the proximal end. The stamen develops, in fact, with the distal end of the filament turned in and down, so that the outer, apparently dorsal, surface of the anther is in reality the ventral surface. This structure of the stamen seems to be typical of the order Ericales. The horns, found in many Ericales on the ventral surface of the anthers, are absent in most Monotropoideae, though conspicuously present in *Pterospora*. We think it significant that rudimentary horns, previously unreported, are present in *Sarcodes*.

The four-grooved pollen grains of *Sarcodes* are like those of

Pterospora and *Pleuricospora*. The pollen grains of *Allotropa* are three-grooved; while those of *Monotropsis* have two grooves.

Copeland (5) expressed the opinion that *Sarcodes* together with *Pterospora* and *Allotropa* make up the most primitive tribe of Monotropoideae, being the link between the Ericaceae proper and other Monotropoideae. The characters of *Sarcodes* as we have come to know them lead us to believe that this is the true conception of the line of evolution.

Sacramento Junior College
Sacramento, California, January, 1940

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A STUDY OF ISOETES IN SAN DIEGO COUNTY, CALIFORNIA

Louis C. Erickson

Three species of *Isoetes* occur in San Diego County, California: *I. Nuttallii* A. Br., *I. Orcuttii* Eaton, and *I. Howellii* Engelm. To these species, eleven names or combinations of names have been applied at various times and the validity of at least one of them, *I. Orcuttii*, has been questioned by Norma E. Pfeiffer, the most recent student of the genus. (Monograph of the Isoetaceae. Ann. Mo. Bot. Gard. 9: 79–232. 1922.) In the present study ecological and morphological aspects of the genus are emphasized. The writer is indebted to Dr. A. W. Haupt and to Dr. Carl Epling, both of the University of California, Los Angeles, for suggestions.

The living material studied came from the Kearney Mesa which is about fifteen miles north of the city of San Diego and five to ten miles inland, and from a pool about eight miles farther north. This area is a table-land drained by a system of small streams which have running water only after rains. These streams retain occasional pools along their courses, eventually drying up completely during the long rainless period lasting from May until November or December. Between streams are low mounds covered with a chaparral vegetation, alternating with shallow depressions which retain water throughout the rainy season and in which many small hydrophytes flourish. A more detailed account of this region may be found in a recent article by

Edith A. Purer (Ecological study of vernal pools, San Diego County. Ecology 20: 217–229. 1939).

Numerous specimens from fourteen localities within the area described were collected at different times of the year. Preserved material, collected in the same region some years previously by Dr. A. W. Haupt and Dr. O. A. Plunkett, was also examined. In addition, types and representative specimens of the following were studied: *Isoetes Suksdorfii* Baker, *I. Nuttallii* A. Br., *I. Orcuttii* Eaton, *I. Howellii* Engelm., *I. nuda* Engelm., *I. melanopoda* var. *californica* Eaton; also representative specimens of *I. Underwoodii* Henderson, the type of which has been destroyed by fire. The following descriptions have been based on the material collected near San Diego.

KEY TO SPECIES

Corm 3-lobed; velum complete
  Peripheral strands in leaves 3; megaspores frosted and predominantly tuberculate ..... 1. *I. Nuttallii*
  Peripheral strands in leaves lacking; megaspores usually glossy and predominantly smooth ..... 2. *I. Orcuttii*
Corm 2-lobed; velum one-third complete ..... 3. *I. Howellii*

1. ISOETES NUTTALLII A. Br. ex Engelm., Am. Nat. 8: 215. 1874; Pfeiffer, Ann. Mo. Bot. Gard. 9: 130. 1922. *I. opaca* Nutt. ex. Engelm., St. Louis Acad. Sci. 4: 388. 1882. *I. Suksdorfii* Baker, Handbook of the Fern Allies 132. 1887. *Calamaria Nuttallii* Kuntze, Rev. Gen. Pl. 2: 828. 1891. *C. Suksdorfii* Kuntze, *l. c.*

Corm 3-lobed; leaves 5–75, mean 21, length 2.5–20 cm., mean 8 cm., spreading, usually with a characteristic twist, stomata numerous, peripheral strands 3, subterranean part of mature leaves occasionally with some brown pigment, velum complete, membranaceous margin up to 5 cm. in length, tapering gradually; megaspores gray (or sometimes white, gray, and dark brown to black within one sporangium), dark brown to black when wet, 260–560 μ, mean 380 μ, the markings variable, from distinctly tuberculate to etuberculate on a frosted or occasionally glazed surface; microspores 25–31 μ, mean 27.5 μ, tuberculate.

Isoetes Nuttallii occupies seepage areas along small streams like those found on Kearney Mesa. In contrast with the other two species, *I. Nuttallii* does not grow where water stands, although the plants may be partially submerged after rains. It was noted in several instances that plants growing in the wetter places were being destroyed by worms and bacteria. The soil in which the plants grow varies from a coarse sand containing a small amount of clay to a clay without sand. Many of the plants are shaded by the chaparral shrubs bordering the streams.

Variation may be observed in (a) number and length of leaves, (b) color, size and marking of megaspores and (c) depth of the

corms in the soil. The number of leaves per plant varies from 5 to 75; their length from 2.5 to 20 centimeters. The plants which have the largest number of leaves are not always the plants with the longest leaves. Most megaspores are gray, but within some sporangia three colors may be found: white, gray, and dark brown to black. When plotted according to size, the megaspores of some individuals produce a bimodal curve. Others have megaspores which, when plotted, produce unimodal curves with small dispersion. Between these extremes are all intermediate conditions, some producing skewed unimodal curves, and some producing less pronounced bimodal curves. The marking on megaspores is variable. Ordinarily they are densely covered with tubercles against a frosted surface. In most sporangia, however, some megaspores usually occur on which the tubercles are wholly or partly suppressed; it is the usual condition for the commissural faces of megaspores to be more prominently marked than the free surfaces. The corms may be covered to a depth of 3 to 4 centimeters or, on the other hand, may be so shallow that the sporangia are visible; all intermediate conditions may be found.

The existence of long-leaved and short-leaved plants, three colors of megaspores in a single sporangia and megaspores which produce bimodal curves when plotted for size may be regarded as evidence of gene mutations.

2. Isoetes Orcuttii Eaton, Fern Bull. 8: 13. 1900; Pfeiffer, Ann. Mo. Bot. Gard. 9: 132. 1922. *I. Nuttallii* var. *Orcuttii* Clute, Fern Allies 253. 1905.

Corm 3-lobed; leaves 3–25, mean 8, length 3–6.5 cm., mean 4 cm., spreading, stomata numerous, peripheral strands none, pigment absent from subterranean portions of mature leaves, velum complete, membranaceous margin 1 cm. or less long, narrow; megaspores gray, dark brown when wet, 220–400 μ, mean 320 μ, smooth and glossy, or rarely frosted, sometimes remotely tuberculate; microspores 23–30 μ, mean 26.5 μ, tuberculate.

Isoetes Orcuttii occupies vernal pools only and is submerged during most of the growing season. After the water evaporates from these pools the plants mature in desiccating soil. In all instances *I. Orcuttii* was found growing in clay soil which is soft when wet and extremely hard when dry.

In contrast to *Isoetes Nuttallii, I. Orcuttii* presents very little variation. The leaves exhibit a considerable range in number (3–25) and in this species the larger leaf numbers are associated with the longer leaves. In leaf length the variation is slight (3–6.5 cm.) and does not show the bimodal tendency found in *I. Nuttallii.* The megaspores are uniformly gray with a characteristically glossy surface. Some of the spores have small remote tubercles, and rarely, some of them may be frosted instead of glossy. The megaspores of *I. Orcuttii* are much more uniform in

size than those of either of the other two species. The corms may be covered to a depth of one centimeter at most.

Isoetes Orcuttii occupies a different habitat from that of *I. Nuttallii* and differs also in the following morphological characters: the leaves are fewer and smaller and peripheral bundles are absent; megaspores are predominantly glossy and smooth and average approximately 60 μ less in diameter than those of *I. Nuttallii*. It is evident that although *I. Nuttallii* and *I. Orcuttii* are similar morphologically they differ sufficiently to be considered distinct species.

3. Isoetes Howellii Engelm., Trans. St. Louis Acad. Sci. 4: 385. 1882; Pfeiffer, Ann. Mo. Bot. Gard. 9: 139. 1922. *I. nuda* Engelm., *l. c.* *I. Underwoodii* Henderson, Bot. Gaz. 23: 124. 1897. *I. melanopoda* var. *californica* Eaton in Gilbert, Working List of N. Am. Pterid. 27. 1901.

Corm 2-lobed; leaves 4–56, mean 22, length 5–28 cm., mean 17 cm., spreading, stomata numerous, peripheral strands 4–12, subterranean part of mature leaves usually with abundant dark brown pigment, velum one-third complete, membranaceous margin extending as much as 3 cm. above the soil level and narrowing gradually; megaspores white, tan when wet, 230–600 μ, mean 430 μ, usually distinctly marked with a combination of tubercles and distinct and anastomosing crests; microspores 27–39 μ, mean 34 μ, tuberculate and occasionally spinulose.

Isoetes Howellii is much more widely distributed than either *I. Orcuttii* or *I. Nuttallii*, for while each of these species is strictly limited to a particular habitat as described previously, *I. Howellii* may be found in association with either or may frequently occur alone. It occurs in shallow, quickly drying pools, in pools which retain shallow water and muddy soil, in deeper pools, or in stream beds which are often shaded by chaparral plants. The population of each pool or stream is very limited in area. It is very improbable that the individuals which occupy one vernal pool or stream interbreed with those of another pool or stream. The sporangia are borne too far below ground level for the spores to be blown by the wind and there are no indications that water runs from one pool to another.

The extent to which these differences in environment influence the plants is not known. Nevertheless, there are striking differences between populations of *I. Howellii*. These differences are most evident in the number and length of leaves and the size of megaspores. The first two populations which are summarized in Table 1 exist in two pools which are separated by about fifty feet of higher ground. The first of these is a shallow depression in which the water stands for a short time after rains and, with the exception of *Isoetes* and *Pilularia*, is quite free from plants during the presence of the standing water. In the other pool the

Table 1.

Differences between populations of *Isoetes Howellii*

	Habitat	Leaf length	No. leaves	Megaspore size
1	partially submerged; not crowded	8–18, mean 14 cm.	14–46, mean 26.5	280–410, mean 350 μ
2	submerged; crowded	10–25, mean 18 cm.	5–20, mean 11	320–480, mean 400 μ
3	partially submerged; not crowded	5–12, mean 8.5 cm.	10–31, mean 17.5	300–450, mean 380 μ
4	submerged; crowded	7–16, mean 11.5 cm.	4–14, mean 8.5	350–600, mean 450 μ
5	shaded	9–18, mean 13.5 cm.	7–26, mean 17	300–580, mean 430 μ

water covers the plants during most of the growing season, since by seepage of water it is kept filled for a longer period. Here the *Isoetes* plants are crowded and are in association with small species of sedges. The differences between these populations are not wholly unexpected. In the widely spaced plants of the first population which grow in shallow water and mud uninfluenced by other plants the leaves are more numerous and shorter than in plants of the second population in which the individuals are crowded and submerged. The size of the megaspores also varies, being smaller by an average of 50 μ in the plants of the drier more open pool.

Another partially submerged population, Table 1 number 3, which grows several miles from the two just described is made up of individuals about two-thirds the size of the partially submerged plants of the first population. Similarly, another submerged crowded population, number 4, is made up of individuals about two-thirds the size of the submerged plants of the second population, in these the megaspores are decidedly larger by an average of 50 μ.

The plants thus far considered have been confined to pools. The last population to be considered, number 5, occupies a stream bed and is shaded to a large extent by overhanging chaparral shrubs. These plants differ noticeably from the others by their darker green, more slender leaves. In other characters they are intermediate.

The range in variation in the size of megaspores of individual plants may be very great. Measurements of 400 megaspores from one specimen, indicated a range of from 280–550 μ a dispersion exceeding those given by Miss Pfeiffer for both *Isoetes Howellii* and var. *minima* Pfeiffer. In morphological characters there is complete intergradation between the species and the variety.

University of California,
Los Angeles, California,
July 24, 1939.

A NEW FRASERA FROM OREGON

Morton E. Peck and Elmer I. Applegate

Frasera umpquaensis sp. nov. Planta biennalis glaberrima; caulis robustus simplex 6–9 dm. altus; folia omnia verticosa foliis verticis 3–4, vel superioribus oppositis, elliptico-oblongis vel late lanceolato-oblongis 1–2 dm. longis ad petiolum brevissimum indistinctum contractis; inflorescentia interrupta densa 1–3 dm. longa ramis infimis in axillis foliorum superiorum, bracteis parvis pedicellis plerumque brevioribus floribus; lobis calycis linearibus vel lanceolato-linearibus paulum inaequalibus 9–12 mm. longis, quoque ad basin intus cristam setarum brevium ferente; corolla viridescente alba paulo breviore calyce profunde 4-partita cristas setarum longarum inter lobos ferente, lobis ad apicem minute 3–4-dentatis, foviis solitariis magnis profundis suborbiculatis in circitu membrana profunde fimbriata marginatis; filamentis anguste linearibus; capsulis compressis.

Glabrous biennial; stem solitary from a short caudex, stout, simple, 6–9 dm. high; leaves all in whorls of 3 or 4 or the uppermost opposite, elliptic-oblong or broadly lance-oblong, 1–2 dm. long, narrowed to very short, ill-defined petioles; inflorescence 1–3 dm. long, interrupted, dense, the lowest branches in the axils of the upper leaves, the bracts above much reduced, the pedicels a little longer to much shorter than the flowers; calyx-segments linear to lance-linear, somewhat unequal, 9–12 mm. long, each with a tuft of short setae at base within; corolla greenish white or pale yellowish, a little shorter than the calyx, deeply 4-parted, with a tuft of long hairs just below each sinus, the narrowly ovate-oblong divisions 3- or 4-toothed at tip, the nectariferous pit near the base large and deep, suborbicular, extending nearly across the segment and bordered all round by a narrow membrane bearing a fringe of long setae, the area below the pit bearing similar setae; filaments filiform, about half the length of the corolla-divisions; capsules compressed.

Type. Anderson Camp, Umpqua-Rogue Trail on the summit of the divide, northwest corner of Jackson County, Oregon, at about 6000 feet elevation, July 11, 1929, *Applegate 5930* (Dudley Herb., Stanford Univ.). Additional collection: slopes of Abbott Butte, Rogue River National Forest, July 2, 1936, *Thompson 13067*.

This large robust plant has the general aspect of *Frasera speciosa* Dougl. and *F. fastigiata* (Pursh) Heller but is more closely related to the latter, having quite similar foveae on the corolla, but differing in the setae and in the characters of the calyx. The species is probably confined to the Cascade Mountains along the divide between the upper Rogue and Umpqua rivers.

Willamette University,
Salem, Oregon,
March 25, 1940.

NEW PLANTS FROM OREGON

Morton E. Peck

The plants here described have been known to the writer for many years, but he has been hesitant about naming them, hoping that they might be assigned to species already published. This having been found impossible, they are now described as new.

Sophora Leachiana sp. nov. Caulis erectus ad basin simplex 3–5 dm. altus minute canescenti-tomentosus; foliis compluribus supra confertis 1–2 dm. longis, foliolis 19–33 late oblongis utroque rotundatis 1.5–2.5 cm. longis tenuibus villoso-tomentosis, subter pallidioribus supra parce adpresso-pubescentibus; racemo terminali 7–15 cm. longo floribus 10–25 in pedicellibus 2–5 mm. longis; calyce late tubulari-campanulato supra valde gibboso 7–9 mm. longo lobis brevibus late triangularibus; petalis flavis 9–12 mm. longis; fructu maturo inviso, immaturo valde sursum curvato terete, inter semina constricta, ut videtur, stipite 3–4 mm. longo; seminibus paucis.

Stem erect, simple below, 3–5 dm. high, finely grayish-tomentose; leaves several, somewhat crowded above, 1–2 dm. long, the leaflets 19–33, broadly oblong, rounded at both ends, 1.5–2.5 cm. long, thin, villous tomentose and paler beneath, thinly appressed-pubescent above; racemes solitary or few, terminal, 7–15 cm. long, the flowers 10–25, on pedicels 5 mm. long or less; calyx broadly tubular-campanulate, strongly gibbous above, 7–9 mm. long, the teeth short and broadly triangular; petals yellow, 9–12 mm. long; mature fruit not seen, immature, strongly curved upward on a stipe 3–4 mm. long, few-seeded, apparently constricted between the seeds, gray-tomentose.

Type. Rand Ranger station near Galice, Josephine County, Oregon, June 18, 1933, *Mrs. Lilla Leach 4343* (type in private herbarium of Mrs. Leach, Portland, Oregon).

Sterile material of this interesting plant was collected in 1921 by Douglas C. Ingram (*1221*) of the United States Forest Service "on the trail to Pea-vine Mt.", probably within a mile or two of the type locality. Mr. Ingram's material was doubtfully referred to *Amorpha* by government taxonomists. Since then Mrs. Leach has collected flowering and young fruiting material near the same locality on three occasions, thus making possible a correct diagnosis. The plant blooms freely but apparently fruits very sparingly. Mrs. Leach has collected very extensively in southwestern Oregon, and would probably have come across the plant elsewhere were it not of extremely local distribution. I take pleasure in adding this to the list of Oregon plants that bear her name.

Sidalcea maxima sp. nov. Caules erecti dense caespitosi 8–12 dm. alti robusti ad basin saepe 1 cm. crassi, glauci glaberrimi

usque ad inflorescentiam; foliis supra glabris subter sparse et minute puberulis, foliis caulinis compluribus inferioribus et radicalibus 6–10 cm. latis prope ad medium 7–9-fissis, segmentis plerumque leve 3-lobatis, mediis et superioribus 3–5-partitis segmentis lanceolatis vel linearibus 3–10 cm. longis; racemis usque ad 2.5 dm. longis infra glabris supra minute puberulis; floribus sparsis; pedicellis brevissimis minute puberulis, bracteis linearibus integris subtentis; calyce 8–13 mm. alto sparse et minutissime stellato, lobis angustis triangulari-ovatis; petalis clare roseo-purpureis latis apice prope truncato 2–3 cm. longis; carpellis (immaturis) dorso levibus.

Stems in large dense clusters, 8–12 dm. high, robust, often 1 cm. thick at base, freely branched from near the base, glaucous and completely glabrous to the inflorescence; leaves glabrous above and nearly so beneath, with only a few minute stellate hairs, the cauline leaves rather numerous, the basal and lower 6–10 cm. wide, cleft nearly to the middle into 7–9 mostly shallowly 3-lobed divisions, the middle and upper cauline parted into 3–5 mostly entire lanceolate or linear divisions 5–10 cm. long; racemes up to 2.5 dm. long, sparsely flowered even in anthesis, the rachis glabrous below, minutely puberulent above; lower flowers of the raceme on slender glabrous stalks 1–8 mm. long, the very short and finely puberulent pedicel subtended by an entire linear bract apparently near the summit of the pedicel; calyx 3–11 mm. high, thinly and very minutely stellate, the lobes narrowly triangular-ovate; petals bright rose-purple, broad, nearly truncate at apex, 2–3 cm. long; carpels (immature) apparently smooth on the back.

Type. On moist bank along Dairy Creek, twenty miles northwest of Lakeview, Lake County, Oregon, July 3, 1927, *Peck 15435* (Herb. Willamette Univ.).

This tall robust plant is characterized by its almost complete lack of pubescence and its large showy flowers.

Sidalcea spicata (Regel) Greene var. **tonsa** var. nov. Folia subter plerumque sine capillis longis; calyx sine capillis longis patentibus, lobis interdum bracteis adpresso-ciliatis; inflorescentia plerumque patentior pedicellis longioribus.

Leaves rarely with any long hairs beneath; calyx without any long spreading hairs, but the calyx-lobes as well as the bracts often appressed-ciliate; inflorescence usually less dense, often with longer pedicels.

Type. Meadow, Big Summit Prairie, Ochoco National Forest, Oregon, June 30, 1932, *Peck 17224* (Herb. Willamette Univ.).

Typical *Sidalcea spicata* is common in the southern counties of Oregon from Curry County to Lake County, reaching its most characteristic development west of the Cascade Mountains. To the north and east of this area it passes gradually into the variety here described. Though numerous intergrades occur along the

indefinite boundary of the ranges, the differences elsewhere are so strongly marked and consistent that it seems advisable to distinguish the two by name. The variety is plentiful throughout most of Oregon east of the Cascades from northern Klamath and Lake counties northward and eastward.

Willamette University,
Salem, Oregon,
March 25, 1940.

FIELD CHARACTERS DISTINGUISHING PINUS PONDEROSA AND PINUS JEFFREYI

Kenneth E. Bradshaw[1]

Western conifers offer relatively few problems in taxonomic differentiation to the field man, but one frequent source of confusion and controversy lies in the similarity between the common western yellow pine (ponderosa pine), *Pinus ponderosa* Dougl. ex Laws. and its close relative Jeffrey pine, *Pinus Jeffreyi* Grev. and Balf. ex A. Murr. These species may be found occupying separate ecological niches (Jeffrey pine has a higher elevational range and occurs on drier sites than western yellow pine and will replace it on serpentine formations at the lower elevations) or they may be found growing intermixed. While certain typical stands or individual trees may be quite readily identified, others defy identification by the use of a simple key and generalized descriptions of the species in question. The following pages contain a list of comparative external features which should greatly facilitate the separation of the two species in the field. Remarks on segregations based on the internal strúctural and chemical qualities of the wood and foliage, which are essentially tasks for the laboratory, have not been included. Grateful acknowledgement is made of certain technical assistance given the writer by Mr. Lloyd Austin of the California Forest and Range Experiment Station.

When using these comparisons, it must be remembered that it is seldom adequate to attempt to identify a tree by using one character to the exclusion of the others. Numerous local strains with distinct morphological and physiological differences result in extreme variation. Certain trees have characters of both species, due probably to cases of inter-breeding. At times but one feature, such as characteristic cones beneath an isolated tree, or distinctly brownish inner bark scale surfaces, may be used as a primary distinction which would point to a Jeffrey pine. Certain trees, however, which otherwise resemble western yellow pine have cones similar to those of the Jeffrey pine or the brownish inner bark scale surfaces characteristic of that species. There-

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YOUNG TREES

Pinus ponderosa	*Pinus Jeffreyi*
FOLIAGE: texture relatively fine, yellow-green, glossy; striae of stomata fine, scarcely distinguishable.	FOLIAGE: needles thicker, longer, coarser, blue-green; powdery white because of the prominent striae of stomata which are well defined and readily counted.
LEADER: flaky bark high on slender leader, length of roughened new growth short; dull gray; resin-filled pustules none.	LEADER: flaky bark not extending so high on the somewhat stouter leader, leaving conspicuous long, smooth, silvery gray area; resin-filled pustules numerous.
BUDS: orange or brick red, conic-ovate, acute; scales closely appressed, surface with resinous exudations, generally in form of numerous tiny droplets.	BUDS: darker with purple or chocolate brown tone; somewhat stouter, more elongate, less acute; scales without resinous exudations, tips less closely appressed.
TWIGS: surface of season's growth shinging green, previous years' growth brownish.	TWIGS: surface of season's growth green, glaucous or pruinose; previous years' growth brownish or greenish but retaining the bloom in perceptible density.
BARK: soft, somewhat resinous; ridges wide, not much inter-connected; furrows shallow, flaky with bark scales; varying from blackish to yellow-brown, tawny or dull orange; inner surfaces of bark scales powdery dull to brilliant sulphur-yellow.	BARK: hard, non-resinous; ridges narrow, irregularly connected giving a braided appearance; furrows deep, distinct, not flaky, laminations of bark very distinct on edges; generally dark gray with slight purplish or reddish-brown cast; inner surfaces of bark scales creamy pinkish- or chocolate-brown.

fore a dominance of one group of characters over the other must be the basis for establishing an identification, unless the tree in question represents a typical case of direct hybridization.

The writer has found that certain characters are best used in the identification of young trees, while others are more serviceable in segregating the older trees. With this consideration in mind, there have been set up practical groups of data for each of these two broad age classes. Trees of intermediate age may be identified by the use of either one of the groups or parts or all of both. Variations in the presence and quality of significant factors with age, size, and condition of the individual trees must be taken into account when using the descriptions contained in this paper. In evaluating the characters of special structures the following modifying conditions should be noted:

FOLIAGE. Foliar differences have been found useful only with the smaller pole-size and seedling trees; they are best used when the two species are growing intermixed so that relative comparisons can be made.

TWIGS. Color of the twigs or previous years' growth has been found to be exceptionally constant as a distinguishing feature; it

Old Trees

Pinus ponderosa	*Pinus Jeffreyi*
Foliage: often perceptibly yellowish; relatively sparse, in ball-like tufts at ends of branchlets, needles persisting approximately 3 years.	Foliage: somewhat blue-green, darker; more dense, needles slightly longer and coarser, persisting 5 to 8 years.
Bark: generally tawny, yellow-brown or dull orange; inner surface of scales, especially near ground level powdery dull to brilliant sulphur-yellow, frequently a distinctive and reliable character; interior of scale brown or tan; scales somewhat soft, a small piece usually dislodged when lightly struck with fingernail; small dark resin pits present throughout.	Bark: externally, color similar to that of *P. ponderosa,* or dark reddish brown, or wine color; plates similar to those of *P. ponderosa* or in more typical specimens somewhat narrower with deeper separating grooves; inner surface of scale light creamy pinkish- or chocolate-brown; interior of scale deep reddish; scales more glossy, harder, merely dented when lightly struck with fingernail; resin pits lacking.
Odor: slight, resinous.	Odor: rather strong, pleasant, sweet, described as resembling that of pineapple, mellow apple, vanilla, or violet.
Limbs: stout, often grotesquely gnarled and bent in very old trees; comparatively short, straight and stout in younger mature specimens, sometimes slightly upturned at ends.	Limbs: less stout and angled, often slender, elongate, more distinctly upturned at ends in typical specimens; retained on bole somewhat longer, resulting in a longer, more symmetrical crown.
Cones: somewhat ovate; about 3–6 inches long, the spreading scales appearing slender and widely spaced; prickles short, the points over most of the cone protruding outward from the umbos, often hooklike, evident to the touch.	Cones: elliptical or long-oval, resembling an old-fashioned bee-hive; about 6 to 10 inches long, scales relatively more numerous, stout, closely compacted, projecting almost horizontally from the cone axis, thus appearing heavier and denser; prickles long, mostly deflexed, the points straight or even slightly turned in, seldom protruding outward except sometimes on the upper 4 to 5 whorls of scales, scarcely perceptible to the touch.

is the only reliable means for determining the species of very young seedlings.

Bark. Ridge and furrow characters are rather distinctive but hard to see on very small trees just beginning to form bark, and not so apparent on trees over sixteen inches in diameter at approximately breast height.

Odor. The use of odor in identification is best employed on older trees, but may be found helpful to supplement the appearance of the bark in young trees which are beyond the stage where the leader and foliage color can be relied upon. Certain individuals of *Pinus ponderosa* and *Pinus Jeffreyi* have disturbingly similar odors, and since hybrids become chemically as well as physically intermixed, this feature should not be relied upon solely. Variation in olfactory sensitivity among observers also decreases the value of this method of differentiation.

Cones. Unopened cones of both species are quite as useful for identification as the opened cones. The immature cones of *Pinus ponderosa* are generally green in color, while the cones of *Pinus Jeffreyi* are generally purple, but there are so many variations and reversals of this rule that color should not be considered an identifying feature in all localities. Cone lengths are also variable, departing from the approximations presented here to such an extent that, except for specimens showing extremes of size, they should be considered much less reliable than the other features mentioned.

Soil Conservation Service,
United States Department of Agriculture
Berkeley, California, December, 1939.

A NEW SPECIES OF ASTRAGALUS FROM ARIZONA[1]

C. L. Porter

Astragalus Beathii sp. nov. Radix perennis; caules plurimi, 4–6 dm. longi, striati seu sulcati, glabri; folia 10–15 cm. longa, foliolis 11–21, plerumque oppositis, nunc ellipticis, obtusis, nunc ovato-obcordatis, basi in petiolulum perbrevem attenuatis; racemi 10 ad 20 flori, floribus densis, purpurascentibus; calyx oblongus, pilis albis, dentibus brevibus lanceolato-subulatis; vexillum ovatum, attenuatum, obtusum, fere 22 mm. longum; carina obtusa; legumen cartilagineum, glabrum, fere 3–4 cm. longum, oblongi-cylindraceum, semibiloculare, polyspermum, sutura superiore obtusa, inferiore introflexa; legumen, sectione transversa, rotundum videatur; semina reniformia, fere 3 mm. longa.

Plants perennial, many stemmed from the summit of a strong taproot, the stems erect, glabrous, striate to sulcate; leaves pinnately 11- to 21-foliolate, 10–15 cm. long, strigose when young, becoming glabrate when mature; leaflets varying from elliptical and obtuse in upper leaves to ovate-obcordate in basal leaves, those of the basal leaves often much smaller, subopposite on the rachis, and narrowed below into a very short petiolule; racemes 10- to 20-flowered, the flowers dense, purple; calyx oblong, white-strigose, the teeth short lance-subulate, about one-third the length of the tube; banner ovate, attenuate at base, obtuse at apex, about 22 mm. long, moderately arched; keel obtuse; legume coriaceous when mature, fleshy when young, sessile or subsessile, glabrous, about 3–4 cm. long, 7 mm. wide and thick, oblong-cylindrical, rounded in cross section, the upper suture obtuse, not prominent, the lower suture intruded and forming a thick septum about 2 mm. high within; seeds numerous, reniform, about 3 mm. long.

[1] Contribution no. 181 from the Department of Botany and the Rocky Mountain Herbarium of the University of Wyoming, Laramie.

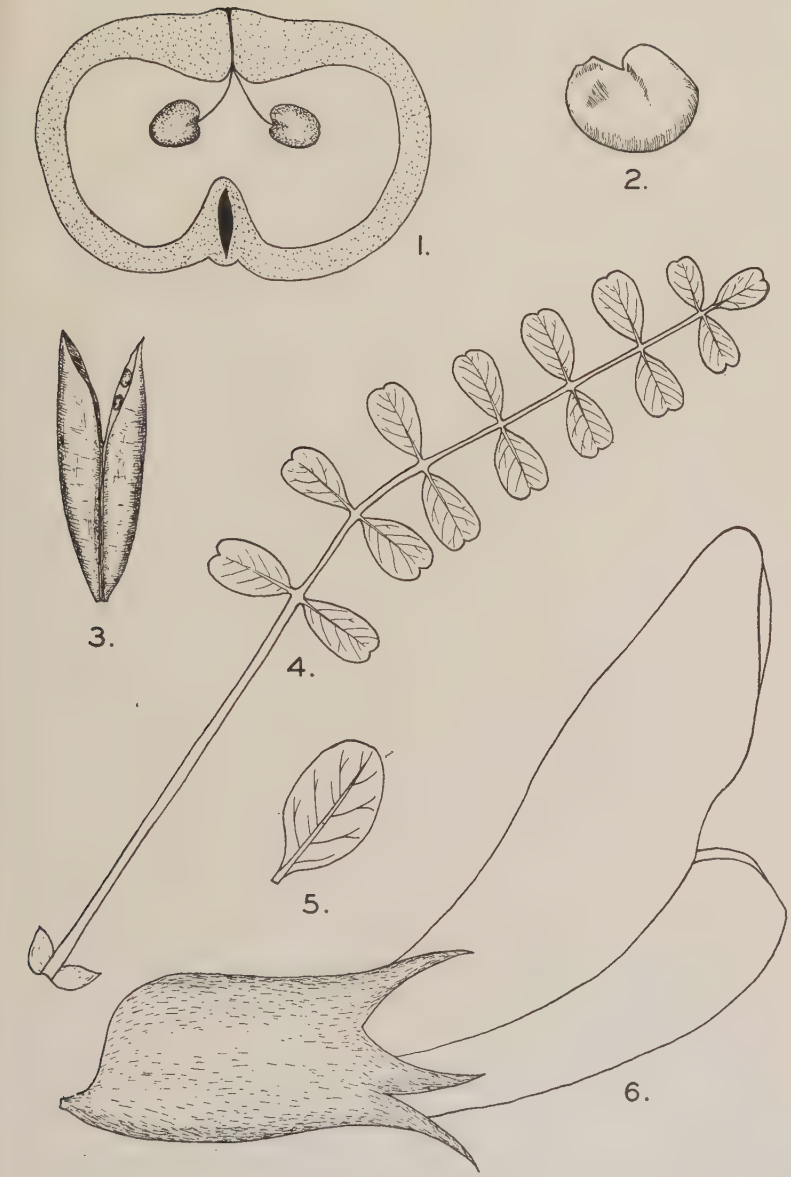

PLATE 3. ASTRAGALUS BEATHII PORTER. FIG. 1, median section of mature pod ×5; fig. 2, seed ×5; fig. 3, mature pod in ventral view ×1; fig. 4, basal leaf ×1; fig. 5, leaflet of cauline leaf ×1; fig. 6, flower ×5.

Type. Two miles south of Cameron, Coconino County, Arizona, June 10, 1939, *L. N. Goodding, Sel. 34–39* (Rocky Mountain Herbarium; isotype, Missouri Botanical Garden).

This species may be referred to section Preusii of Jones (Rev. Astrag. 1923) and to the genus *Jonesiella* of Rydberg (N. Am. Fl. 24: 401. 1929). The elongated, straight, cylindrical, sessile or subsessile pods and the dark purple flowers, as well as the erect many-stemmed growth from a strong taproot will readily distinguish it from any of its near relatives. It appears to be very limited in distribution, being found only in the type locality as far as is known, but there it is quite abundant and conspicuous.

The writer takes pleasure in naming this plant for Professor O. A. Beath who first discovered it while on a field trip in connection with his work on seleniferous plants. Since he was unable to obtain mature fruit at the time he first saw it, he informed Mr. L. N. Goodding of the locality and it was through Mr. Goodding that the type material was later obtained.

University of Wyoming,
Laramie, January 24, 1940.

ALBERT RADDIN SWEETSER

(1861–1940)

In the death of Dr. Albert Raddin Sweetser the Pacific Coast has lost one of its best-loved teaching botanists. Dr. Sweetser was born at Mendon, Massachusetts, July 15, 1861, the son of a Methodist minister. His early education was obtained in Massachusetts, in the public schools and at Wilbraham Academy. Entering Wesleyan University, Middletown, Connecticut, in 1880 he received from that institution the degree of Bachelor of Arts in 1884 and of Master of Arts in 1887. Then followed a year at Massachusetts Institute of Technology, where he took special work in chemistry. His first teaching was done in the public schools, Cape Cod, and later at Bucksport, Maine, where he taught in a Methodist seminary. While at Bucksport, in 1888, he was married to Carrie K. Phinney, whom he had met on Cape Cod. His next teaching position was in a Methodist school at Tilton, New Hampshire. In 1893 he entered the Harvard Graduate School of Botany, and remained there for four years. During his last two years at Harvard he was an assistant in botany and at the same time was teaching in Radcliffe College. In 1897 he accepted an invitation to join the faculty of Pacific University at Forest Grove, Oregon. He went to the University of Oregon in 1902 as Professor of Biology, and in 1909 became head of the Department of Botany, a position he occupied until his retirement in 1931. In that year the faculty of the University of Oregon conferred upon him the honorary degree of Doctor of Science.

Plate 4. Albert Raddin Sweetser.

He died at Eugene, September 12, 1940, at the age of seventy-nine years.

Dr. Sweetser was co-author with Mary E. Kent of a small popular "Key and Flora" of Oregon, and the author of a number of shorter scientific articles. During the later years of his life he became greatly interested in the botanical history of the Pacific Northwest, and has left a great deal of collected material on this subject, none of which, unfortunately, has been published.

His greatest contribution, however, has been as a teacher, and it was in this field that he himself felt that his most important work lay. His deep understanding of the problems of young people, his kindly personal interest, and his keen sense of humor have endeared him to the many students who have come in contact with him during his years of instructing. It was his purpose to build an appreciation of nature in as many people as possible, and to this end he wrote a considerable number of popular botanical articles for newspapers and journals and accepted frequent invitations to lecture before various clubs. Another of his major interests was the conservation of the native flora and much of his work was directed to that end.

He was a member of Sigma Xi, the American Association for the Advancement of Science, the Medical Society of America, the Society of American Bacteriologists, the Botanical Society of America, the American Association of University Professors, the National Geographic Society, and an associate member of the American Museum of Natural History.—LeRoy E. Detling, University of Oregon, Eugene.

A NEW SPECIES OF PARONYCHIA FROM MEXICO[1]

Earl L. Core

While checking over several sheets of *Paronychia* from various herbaria, the writer came across a specimen from the collection of Dr. Edward Palmer which apparently belongs to an undescribed species. For this plant the following name is proposed:

Paronychia albomarginata sp. nov. Herba perennis, e caudice crasso lignescente; caule ramosissimo a basi incipiente, 4–7 cm. longo, puberulente cum internodis numerosis brevis; foliis linearibus vel linearibus-oblongis, puberulentissimis, 3–4 mm. longis, acutis vel mucronatis a stipulis celatis; stipulis argenteis folia aequantibus vel excedentibus; bracteis brevioribus quam flores vix eis paribus; cymis parvis; calycis segmentis 2 mm. longis, puberulentibus, cum marginibus albis conspicuis, in cuspide breve et erecta terminantibus; staminibus sepalorum longitudine dimidiis.

[1] Contribution No. 12 from the Herbarium of West Virginia University.

Perennial from a thick woody tap root; stem much branched from the base, 4–7 cm. long, puberulent, with numerous short internodes; leaves linear or linear-oblong, densely puberulent, 3–4 mm. long, acute or cuspidate, hidden among the stipules; stipules silvery, ascending, equaling or exceeding the leaves; bracts shorter than or barely equaling the flowers; cymes small, few-flowered; sepals 2 mm. long, puberulent, with conspicuous white margins, tipped by a short erect cusp; stamens half the length of the sepals.

Type. Saltillo, State of Coahuila, Mexico, April 9, 1905, *Edward J. Palmer 518* (Britton Herbarium, New York Botanical Garden; co-type in Herbarium of Missouri Botanical Garden).

This plant is obviously related to *Paronychia Wilkinsonii* S. Wats., from which species it differs principally in the length of the sepal awns, which in *P. Wilkinsonii* are half the length of the sepals or longer and widely spreading, whereas in the present species they are very short and erect. Other differences are in the leaves, which in *P. Wilkinsonii* are 4–6 mm. long, in *P. albomarginata* only 3–4 mm. long; in the stipules, which in *P. Wilkinsonii* are widely spreading, about equaling the leaves, and in the present species erect, generally exceeding the leaves; and in the size of the flowers, about 3 mm. long in *P. Wilkinsonii,* and only about 2 mm. long in *P. albomarginata.*

West Virginia University,
Morgantown, West Virginia,
March 7, 1940.

GREAT BASIN PLANTS—III. CARYOPHYLLACEAE

Bassett Maguire

The North American pinks have received no serious study[1] since the revision by Robinson in 1897. Progress in the knowledge of our western forms has undergone little advancement since. In attempting to identify new material and to order that of the herbarium more than ordinary difficulty has been encountered, due to this lack of progress and to the multiplicity of forms occurring in recent collections. In his treatment of the family, Robinson (4) constantly referred to the complexity and confusion existing in its taxonomy. Hultén (2, p. 166) has remarked concerning a segregate of *Cerastium Beeringianum,* "Owing to the great variability and lack of distinctive characters the taxonomy of the above-mentioned plants is very confusing." This statement might well apply to the entire family and, in our concern, particularly to the family in our region.

[1] The first part of the revision of the Western Hemisphere members of *Spergularia* by Dr. R. P. Rossbach appeared in the March, 1940, issue of Rhodora.

In anticipation of further more extended studies, the following preliminary report may now be made.

Cerastium Beeringianum Cham. & Schlecht. var. grandiflorum (Fenzl.) Hultén. From a considerable and diversified population which apparently must come under the above specific name, the variant with petals exceeding 9 mm. (following Hultén) is probably best referred to var. *grandiflorum*. This variety is apparently a new record from our region. These plants possibly represent also *C. pulchellum* Rydb. and *C. Earlei* Rydb.

Arenaria Fendleri Gray subsp. genuina nom. nov. *A. Fendleri* Gray, Mem. Am. Acad. n. ser. 4: 13. 1849.

Arenaria Fendleri Gray subsp. brevifolia subsp. nov. Caudicibus multicipitalibus, caulibus numerosis, plerumque basibus foliorum vestito, 4–20 cm. altis; foliis 1–3 (6) cm. longis; inflorescentibus 1–3 (5) cm. longis, glandulosis; sepalis anguste lanceolatis, acutis; petalis elliptico-oblongis, obtusis vel retusis, 7–9 mm. longis.

Stems numerous, 4–20 cm. high, from a multicipital caudex borne on a thick root, the stem bases conspicuously clothed with grey-brown remains of previous leaves; leaves 1–3 (6) cm. long; inflorescence open or somewhat congested, 1–3 (5) cm. long, conspicuously glandular-pubescent; sepals narrowly lanceolate, acute, hardly acuminate, the inner more broadly scarious-margined, 5–7 mm. long; petals elliptic-oblong, obtuse or merely retuse, 7–9 mm. long, claws 1–2 mm. long; capsule shorter than the sepals.

Type. Meadow, 11,300 feet, Burro Pass, La Sal Mountains, Grand County, Utah, July 18, 1933, *Bassett Maguire et al. 17972.* Cotypes. La Sal Mountains, *Bassett Maguire et al. 1777, 17973, 17974;* Abajo Mountains, San Juan County, Utah, *Maguire & Redd 1175.* (Type and cotypes are deposited at Utah State College.)

Plants of meadows or open slopes and ridges from 10,000 to 13,000 feet known only from the La Sal and Abajo mountains of Grand and San Juan counties, Utah, and one collection (*Maguire 12254*) from Kaibab National Forest, Coconino County, Arizona.

This population is distinguished from the Rocky Mountain race by its shorter leaves, longer petals, somewhat broader and less attenuate sepals, and shorter inflorescence. At the highest elevations it passes into the variant, described below, with much reduced leaves and stems, distinctly the alpine ecotype of the plant of subalpine, Canadian, and Hudsonian habitats.

Arenaria Fendleri Gray subsp. brevifolia var. brevicaulis var. nov. Caulibus plerumque 4–8 cm. longis, foliis 1–2 cm. longis.

Stems mostly 4–8 cm. long; leaves mostly 1–2 cm. long; sepals occasionally only 4 mm. long.

Type. Summit of Pilot Mountain, 12,400 feet, La Sal Moun-

tains, Grand County, Utah, July 11, 1933, *Bassett Maguire et al. 17976.* Cotypes. La Sal Mountains, *Maguire et al. 17977, 17978, 17979, 17980.* (Type and cotypes are deposited at Utah State College.)

This low compact plant is evidently the western correlative of var. *Porteri* Rydb. (of which the isotype, *M. E. Jones 716,* is deposited at this institution) of *Arenaria Fendleri* subsp. *genuina.* It is probable that var. *brevicaulis* represents, at least in part, *Arenaria compacta* of the manuals of "Utah." It would seem improbable that our plant is conspecific with *A. compacta* Cov. of California, although Coville (1, p. 67) compares it with *A. Fendleri,* since var. *brevifolia* is definitely a phase of *A. Fendleri,* whereas this latter species does not occur to the west of the Great Basin.

Arenaria capillaris Poir. subsp. formosa (Fischer) comb. nov. *A. formosa* Fischer, in De Candolle, Prodromus 1: 402. 1824.

This entity, apparently not before recorded from Nevada, represents the typical American form of *A. capillaris.* The polymorphic population of subsp. *formosa* has developed a number of variants, the definition of which is not yet clear. This subspecies is represented by the following collections: San Jacinto, Elko County, Nevada, June 13, 1939, *Maguire 16811, 16812;* Diamond A Ranch, vicinity of Jarbridge, Elko County, Nevada, May 29, 1939, *C. York.*

Arenaria aberrans M. E. Jones. A striking *Arenaria* suggesting *A. capillaris* but with immense urnulate capsules resembling those of *Silene* was collected under pine woodland near the south gate of Grand Canyon National Park (Coconino County, Arizona, June 27, 1935, *Maguire 12236*). These plants are undoubtedly an offshoot of *A. capillaris* but have undergone such extreme divergence as to necessitate recognition as a distinct species. It was not realized that this collection represented the second one made of the recently described *A. aberrans* M. E. Jones (Contrib. West. Bot. 37. 1930) ascribed to "Box Elder Co., Utah." The type (*W. P. Cottam 4159*), however, actually came from Mount Dellanbough, Mohave County, northern Arizona, about eighty miles west of our station.

Arenaria Eastwoodiae Rydb. var. adenophora Kearney & Peebles. This interesting desert ecotype, recently described (1939) from the vicinity of Tuba, Coconino County, Arizona, extends northward, as might have been expected, into southeastern Utah. Collections of this variant from San Juan County, Utah, are represented by the following: June 29–July 1, 1933, *Maguire 2900, 5901, 5902, 5903.*

Silene Petersonii sp. nov. Rhizomate gracile, cum gemmis conspicuis nodis; caulibus solitariis vel laxe multicipitalibus, 5–15

cm. altis, simplicibus, aspere retrorse glanduloso-pubescentibus, plus dense nodis; foliis oblanceolatis, 2–3 cm. longis, 4–6 mm. latis, 1-nerviis, aspere glanduloso-puberulis vel scabris; floribus 3–7, raro 1; calycibus campanulato-cylindricalis vel inflatis, 1.5–2 cm. longis, membranis, conspicue 10-nerviis (nervis purpureis) glanduloso-pubescentibus, lobis oblongo-ovatis, obtusis, 4–6 mm. longis, glanduloso-ciliolatis, corollis conspicuis exsertis, roseis ad roseo-purpureis, petalis 2–3 cm. longis, limbis cuneatis, tenue dentatis vel 4-lobatis, lineari-oblanceolatis; capsulis ovato-oblongis, seminibus 2–2.5 mm. latis, tuberculis marginalibus bullatis.

Tap root deep set, giving rise to several slender, light brown rhizomes, 1–2 mm. in diameter, producing conspicuous nodal buds, the rhizomes horizontally extensive, branching, giving rise to single or several loosely multicipital branches; stems simple, 5–15 cm. high, harshly and retrorsely glandular-pubescent; leaves oblanceolate, 2–3 cm. long, 4–6 mm. broad, broadly or narrowly sessile by means of connate, sheathing hyaline bases, 1-nerved, harshly glandular-puberulent, the upper leaves somewhat reduced; flowers 3–7, or seldom only 1, nodding during anthesis, pedicels 1–2.5 cm. long, seldom only 5 mm. long, calyx campanulate-cylindrical, conspicuously inflated at maturity, 1.5 (1)–2 cm. long, membranous, sometimes purple-tinged, conspicuously 10-nerved (nerves purple), glandular-puberulent, the hairs frequently pigmented, lobes oblong-ovate, obtuse, 4 (3)–6 mm. long, glandular-ciliolate; corolla conspicuously exserted, pink to rose-purple, petals 2 (1.5)–3 cm. long, the blade broadly cuneate, irregularly toothed, shallowly lobed, or 4-cleft into linear-oblanceolate lobes, the lateral smaller, appendages inconspicuous, claws broad, gradually narrowed to the base; capsule ovate-oblong, somewhat shorter than the calyx, opening by 6 smooth valves, (rarely 4 or 5), stipe 1–2 mm. long, styles 3; seed 2–2.5 mm. broad, laterally compressed, brown, with a conspicuous broad marginal crest of bullate tubercles.

Type. Common on steep, loose, bare, calcareous slopes at 10,900 feet, Skyline Drive, one mile above Baldy Ranger Station, Manti National Forest, Sanpete County, Utah, August 8, 1940, *Bassett Maguire 20000* (Utah State College). Cotypes. Loose calcareous sand-clay rim, frequent at 10,500 feet, one-half mile east of museum, Cedar Breaks National Monument, Iron County, Utah, July 12, 1940, *Bassett Maguire 19465;* frequent in bare gravelly clay on rapidly eroding slopes, Red Canyon, Garfield County, Utah, July 16, 1940, *Bassett Maguire 19550.*

Other collections. Utah. Iron County: Cedar Breaks, August 12, 1938, *Hitchcock, Rethke & van Raadshooven 4582,* August 7, 1934, *Maguire 17977,* August 13, 1939, *Maguire 17566,* June 23, 1940, *Maguire 19019,* July 12, 1940, *Maguire 19481,* August 18, 1940, *R. T. Clausen & H. Trapido 5109.* Garfield County: Red Canyon, August 9, 1934, *Maguire 17987,* June 25, 1940, *Maguire 19060,*

July 16, 1940, *Maguire 19533,* July 16, 1940, *Maguire 19556;* Pink Cliffs at 9000 feet, Table Cliff Plateau, Powell National Forest, June 26, 1940, *Maguire 19121.* Sanpete County: Sky Line Drive, August 8, 1940, *Maguire 19989,* August 8, 1940, *Maguire 20001* (topotypes).

It is fitting that this attractive new *Silene* be named in honor of Dr. E. G. Peterson, President of Utah State Agricultural College, who made possible the establishment of this herbarium, and who since, by constant sympathy and personal encouragement has been most helpful in the progress of its work.

Lychnis Drummondii (Hook.) Wats. In Utah and the Great Basin the tall-stemmed *Lychnis* has been recognized as representing the three following species: *L. Drummondii,* with "included corolla" and "sessile capsule"; *L. nuda,* with "exserted, 4-lobed petals," "inflated obovate calyx," and "stipitate capsule"; and *L. striata,* with "exserted 2-lobed petals," "oblong calyx" and "sessile ovary."

Specimens recently collected in Utah show these characters in the following combinations, but with all degrees of intermediacy obtaining. Plants of the latter characters show no ecological or geographical segregation, hence are at most only varietally distinct: (a) corolla more or less included, petals bifid or lobed, ovary subsessile or short-stipitate, calyx ovate-oblong; (b) corolla more or less exserted, petals (2-) 4-cleft or lobed, ovary subsessile or short-stipitate, calyx ovate-oblong.

Robinson (4) reduced *Lychnis nuda* Wats. to *Silene pectinata* var. *subnuda,* citing the Watson Humboldt Mountains collection and, without number, two collections of M. E. Jones: "Near Empire City and at Franktown, Nev." A collection from Empire City, Nevada (June 19, 1882, *M. E. Jones 3795,* Utah State College no. 5746), although immature, is without question *Lychnis* and probably represents part of the series cited by Robinson. It would seem then that Robinson was probably in error in the transfer. Tidestrom (5, p. 200) accepted the name of Watson as representing a valid species. Nelson (3) reduced the name *L. striata* to synonomy under *L. Drummondii.*

The writer has not seen the type of *Lychnis nuda* and realizes that the "inflated calyx" does not obtain in *L. Drummondii.* However, since the Utah material, which surely represents but a single major species, transcends the characterization of these three formerly proposed entities, it seems best to treat the plants with exserted and mostly 4-lobed or 4-cleft petals as a variety:

Lychnis Drummondii (Hook.) Wats. var. **nuda** comb. nov. *L. nuda* Wats. in King, Geol. Expl. 40th Par. 5: 37. 1871. *L. striata* Rydb. Bull. Torr. Club 31: 408. 1904.

Utah State Agricultural College,
Logan, Utah, April, 1940.

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A NEW LIMNANTHES FROM OREGON

LeRoy Abrams

Limnanthes Howelliana sp. nov. Caules ex basi 1 vel plures, 12–25 cm. alti, succulenti, glabri. Folia glabra, infera 5–8 cm. longa, infra divisionibus 2- ad 3-lobatis, supra integris, linearioblongis vel linearibus; sepala lanceolata, acuta, 7–8 mm. longa, glabra; petala alba, basi flava, obovata, emarginata, 12–16 mm. longa, apice subtruncato et late emarginato, infra 9-nervia, infra medium sparsim longo-villosa; carpella dense obtuso-tuberculata.

Stems one to several from the base, 15–25 cm. high, rather succulent, glabrous. Leaves glabrous, the lower 5–8 cm. long, lower divisions 2- to 3-lobed, the upper entire, linear-oblong or linear; sepals lanceolate, acute, 7–8 mm. long, glabrous; petals white with yellow base, obovate, emarginate, 12–16 mm. long, 6–7 mm. wide at the subtruncate broadly emarginate apex, 9-nerved below, sparsely long-villous below the middle; nutlets thickly beset all over with broad mammillate tubercles.

Type. Roadsides and fields near Wilbur, Douglas County, Oregon, April 8, 1894, *J. W. Thompson 10161* (Dudley Herbarium 230576). Other collections of this species in Dudley Herbarium are: ditch north of Oakland, *J. W. Thompson 4390;* Yoncalla, *J. W. Thompson 186.* All of these stations are in Douglas County on the Umpqua River watershed.

Thomas Howell gave a good description of this species in his "Flora of Northwest America" under the name *Limnanthes Douglasii* R. Br. and I therefore take pleasure in naming it in his honor. It differs from *L. Douglasii,* a species of the Coast Ranges of central and northern California, in several characters. The nutlets of that species are smooth or crowned at the apex with a few tubercles, the leaflets or divisions several-toothed or -lobed, whereas in *L. Howelliana* they are entire or the lower 3-lobed, as in *L. alba* Hartw. *Limnanthes rosea* Hartw. has the nutlets thickly beset all over with protuberances, but they are thin, scale-like and whitish.

Four other species of *Limnanthes* have been described from southern Oregon: *L. Bellingeriana* M. E. Peck, *L. floccosa* Howell, *L. gracilis* Howell, and *L. pumila* Howell.

Dudley Herbarium, Stanford University,
California, February 5, 1940.

REVIEWS

The Cacti of Arizona. By Lyman Benson, J. J. Thornber, and A. A. Nichol, with line drawings and three color plates by Lucretia Breazeale Hamilton. University of Arizona Bulletin volume 11, no. 1, pp. 1–134, with 52 plates, 6 in full color, and colored frontispiece. (Biological Science Bulletin no. 4 [or 5?]) University of Arizona, Tucson, Arizona, January, 1940. $1.00.

This semipopular bulletin on the cacti of Arizona was published to fill the place left vacant by the exhaustion of the supply of Biological Science Bulletin no. 1, by Stockwell and Breazeale, issued in 1933. The discrepancy between the bulletin number shown on the cover and that appearing on the title page is puzzling, for the cover bears the legend "Biological Science Bulletin No. 5" while on the title page it is called "Biological Science Bulletin No. 4." One also wonders about the date, January 1, 1940, although it is not impossible that the bulk of the stock of bulletins was not distributed until some eleven months later.

However, these minor details detract not one whit from the value of this handbook of the Arizona cacti. It is well planned, carefully written, and beautifully illustrated with plates in full color, half-tone, and line drawings. The profuse use of illustrations fulfills the authors' hope that ". . . the more common cacti may be recognized without resort to the keys." The keys are formal, dichotomously constructed and workable. The number of technical terms used in keys and descriptions has been held to just about the minimum, and those used, tersely defined in a short glossary or in the introductory paragraphs.

Distribution maps show the range, within Arizona, of sixty of the more important species recognized as occurring within the state. It is regrettable that the base maps, upon which the distribution is shown in green, were not drawn with bolder lines and with fewer intricate topographical details, for one must compare them with larger scale maps to determine with any assurance the position of many of the limits of distribution. The maps are valuable in that in spite of the indistinct details they graphically present the general distribution of the species so treated.

The taxonomic treatment of the genera is conservative, *Carnegiea, Lophocereus, Lemaireocereus, Peniocereus,* and *Wilcoxia* all being lumped in the older genus *Cereus.* In like manner, *Echinocactus* becomes the repository for *Ferocactus, Echinomastus, Sclerocactus, Utahia,* and *Toumeya,* while *Coryphantha, Escobaria,* and *Phellosperma* are relegated to synonymy under *Mamillaria.* This is in keeping with the generic treatment of these groups by several Europeans who have dealt with the cacti during the past decade, and may reflect a reaction to the criticism occasionally voiced concerning the treatment of Britton and Rose to the effect that these two gentlemen recognized too many genera and too few species. The authors' concept of species seems to be more liberal than their definition of genera, for they recognize ten species of

Echinocereus, the validity of some of which has been questioned by cactus fanciers who usually allow quite narrow specific delimitations. Again, both *Opuntia ursina* and *O. erinacea* are given full specific value. (I'd do the same myself.) In other instances they have refrained from attempting to evaluate some of the more troublesome complexes in *Opuntia* and *Mamillaria,* frankly stating that several more years of critical study must be given these puzzling groups. In spite of what one's personal opinion may be concerning the treatment of the genera, the taxonomic treatment in this book is a practical one and doubtless will prove admirably "usable" to many westerners and travelers interested in the southwestern flora. The first hand information supplied by these men who have studied the cacti of Arizona at all seasons will be most valuable to botanists to whom opportunities for field work in the Southwest come infrequently.

The brief section dealing with the culture and care of cacti is sufficient for handling most of the native species. A. A. Nichol, who wrote this section of the book, refrained from giving detailed specifications, but included the necessary general hints covering the soil, water and light requirements of most of the Arizona cacti.

The book is well printed on glazed paper, with paper cover, and at the modest price of one dollar should find wide acceptance among botanists and cactus growers. The illustrations make it an excellent book for the non-professional who is interested in making a "speaking acquaintance" with the dwellers of the arid Southwest.—Ira L. Wiggins, Dudley Herbarium, Stanford University.

Flora of Indiana. By Charles C. Deam. Department of Conservation, Division of Forestry. Pp. 1–1236, maps 1–2243, 4 unnumbered maps and frontispiece. Indianapolis, Indiana. 1940. $3.50. (Send order to State Forester, State Library, Indianapolis, Indiana.)

Dr. Deam has set a new high standard for regional floras. This volume will be a constant source of reference not only for students of the Indiana flora but for all those engaged in floristic studies. Every effort has been made to present a complete and accurate picture of the flora of Indiana. Dr. Deam has incorporated the results of field studies carried on through years of travel. Every species listed in the flora is based upon actual and accessible specimens and in many cases the identifications have been checked by specialists. Certain parts of the text have been contributed: the genera *Carex, Juncus* and *Luzula* by Frederick J. Hermann; Chenopodiaceae by Theodor Just; *Crataegus* by Ernest J. Palmer. Distribution maps are included for each species. These maps show not only the location but also the time of flowering and the herbaria in which the specimens are located.

The author has included a discussion of the floral areas of Indiana; a list of names of collecting places; a reference list of

Indiana collectors; and a bibliography of the Indiana flora. Ecological notes are given for many of the species and since these are based on the author's own observations they are of particular value.

The flora will undoubtedly be considered a model of excellence and thoroughness. Every student and writer of floras will do well to consult it not only as a model of form but because of the invaluable information which it contains. Such a volume should be a constant companion in the field; it is to be regretted that it was impossible to publish all this material in a form more suitable for field use.—Mildred E. Mathias, Department of Botany, University of California, Berkeley, California.

NOTES AND NEWS

Ribes petiolare dougl. in California. Occurring generally along streams and on moist sites from British Columbia south through the intermountain region to southern Oregon and Arizona, *Ribes petiolare* was first reported from California by George A. Root in 1937 (California Ranger 8^9: 4, 1937). The species was found by Root and Hollis Day along Shovel Creek in Shasta National Forest, Siskiyou County, about nine miles south of the California-Oregon boundary line. In the same report Root mentions finding a few bushes of *R. petiolare* one and one-half miles north of the boundary line on Kelley Creek near Lakeview, Lake County, Oregon, at the northern end of the Warner Mountains; he did not see it farther south in Modoc National Forest, California. In reviewing Root's report, Clarence R. Quick (Madroño 4: 286–290. 1938) mentions observing *R. petiolare* in abundance on Crane Creek a few miles north of Kelley Creek in Oregon; he also was unsuccessful in finding the species south of the line in the Warner Mountains.

In July, 1939, the writer, while examining specimens in the herbarium of the United States Forest Service at Alturas, California, noted a collection of *Ribes petiolare* from "Lost Lake-Silver Creek" in the southern Warner Mountains, Modoc National Forest, made August 13, 1918, by Associate Forester L. S. Smith. It bore the numbers 1033 and 31510, the latter the accession number of the Herbarium of the United States Forest Service, Washington, D. C., to which Mr. Smith sent a portion of his collection. Dr. Frederick V. Coville verified the determination. The following herbaria have been consulted for records or specimens, but with negative results: University of California, Berkeley, California Academy of Sciences, Stanford University, United States Forest Service and Division of Plant Exploration and Introduction, Washington, D. C. Apparently Mr. Smith's collection constitutes the earliest known record of the species in California and establishes its occurrence approximately seventy miles south of the Oregon line.

Additional specimens were obtained by G. A. Zentmyer and the writer from the same locality, July 30, 1939, and a portion of this collection has been deposited in the Herbarium of the University of California, Berkeley. The species was observed in abundance along Silver Creek and several of its tributaries about one-half mile southwest of Lost Lake (particularly in Sec. 15, T.38 N., R.16E., Mt. Diablo Meridian). It was not found by the writer north of this locality in the Warner Mountains.

The occurrence of *Ribes petiolare* near Lost Lake is considered of significance from the standpoint of blister rust control. The species is one of the most susceptible of western currants and dense concentrations of the bushes grow there in close association with an abundance of whitebark pine (*Pinus albicaulis* Engelm.), which according to present information is considerably more susceptible than other western white pines. The rust, however, was not found on either pines or currants at this place.—J. L. Mielke, Division of Forest Pathology, Bureau of Plant Industry, United States Department of Agriculture, San Francisco, California.

In a recent issue of "Science" appeared an announcement of the death on August 20, 1940, of Dr. Joseph Burtt-Davy, lecturer in tropical botany at the Imperial Forestry Institute, Oxford. From 1893 to 1903 Dr. Burtt-Davy was connected with the University of California, first as a student assistant, later as instructor in botany and assistant botanist in the Agricultural Experiment Station. He left California to accept an appointment as agrostologist and botanist in the Department of Agriculture, Pretoria, South Africa. Soon after the close of the World War he returned to England and was for some time engaged in the preparation of "A manual of the flowering plants and ferns of the Transvaal with Swaziland, South Africa," parts one and two of which were published in 1926 and 1932 respectively. During his sojourn in California Dr. Burtt-Davy, in connection with his studies on agronomy, visited many parts of the state and made collection of grasses and other forage plants; these collections, amounting to about two thousand numbers, are deposited in the University of California Herbarium. From 1896 to 1900 he published a number of articles in "Gardeners' Chronicle," "The Pacific Rural Press," and as bulletins of the University of California Agricultural Experiment Station and the United State Department of Agriculture; he also contributed more than fifty short articles to "Erythea." While in Berkeley he married Alice Bolton. Dr. Burtt-Davy is well remembered by the older faculty members of the University of California.

Important monographic studies published during the current year and not previously noted in Madroño are: "the genus *Ellisia,*" by Lincoln Constance (Rhodora 42: 38–39. 1940); "the genus *Dichelostemma,*" by Robert F. Hoover (Am. Midland Nat. 24: 463–

476. 1940); "studies in *Penstemon* VII, the subsections Gairdneriani, Duesti, and Arenarii of the Graciles . . . ," by David D. Keck (Am. Midland Nat. 23: 594–616. 1940); "a revision of the North American species of the genus *Thermopsis,*" by M. M. Larisey (Ann. Mo. Bot. Gard. 27: 245–258. 1940); "a monograph of the genus *Symphoricarpos,*" by George Neville Jones (Journ. Arnold Arbor. 21: 201–252. 1940); "studies in the genus *Hedysarum* in North America," by R. C. Rollins (Rhodora 42: 217–239. pl. 597. 1940); "*Spergularia* in North and South America," by R. P. Rossbach (Rhodora 42: 57–83, 158–193, 203–213. pls. 589–596. 1940).—Ethel Crum.

Approximately five-hundred fifty species and varieties of native Californian and cultivated trees are included in a recent publication "Trees of Santa Barbara" by Maunsell Van Renssaeler of the Santa Barbara Botanic Garden, California. Descriptions are brief and non-technical and exact locations of more than eight-hundred specimen trees are given. For convenient reference genera are arranged alphabetically, and both common and scientific names are listed in the index. The book of 141 pages is very attractive in format and is illustrated by a large number of excellent photographs and line drawings. Among those represented by full page photographs are the following native Californian species: *Ceanothus arboreus, Fremontia mexicana, Lyonothamnus asplenifolius, Pinus Torreyana, Platanus racemosa.* (Price: paper, $.75, cloth, $1.50.)—Ethel Crum.

Under the title "Alien plants growing without cultivation in California," Dr. W. W. Robbins lists approximately 526 species with comment as to the dates of their introduction into California, their habitats and distribution and their importance as weeds or forage. The pamphlet consists of 128 pages of which thirteen are devoted to introductory discussion, ninety-eight to comment on the species, seven to literature cited and fourteen to a comprehensive index of common and scientific names. The publication appeared July, 1940, as Bulletin 637 of the Agricultural Experiment Station, University of California, Berkeley.

At the Thirty-Fifth Annual Meeting of the Botanical Society of America, December 28, 1940 to January 1, 1941, Philadelphia, papers by the following botanists of western states were scheduled: E. L. Little, Southwestern Forest and Range Station, Arizona; James Bonner, J. van Overbeck, California Institute of Technology; D. L. Arnon, Ernest Ball, Donald E. Bliss, R. W. Chaney, R. E. Clausen, Lincoln Constance, Frank Cuneo, Carl Epling, Katherine Esau, A. S. Foster, D. R. Hoagland, Flora Murray Scott, F. M. Turrell, University of California; G. H. Rossbach, Stanford University; Joseph Ewan, University of Colorado.